

WHAT IS CLAIMED IS:

1. An image processing method to detect a target image including a set of a plurality of pixels in each of a plurality of image object regions, comprising:  
when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, a group of boundary pixels interposed between a first group of pixels that constitute the first image object region and a second group of pixels that constitute the second image object region being detected as a boundary region between the first image object region and the second image object region based on pixel information on the pixels and predetermined region-determining conditions.
2. An image processing method to divide a target image including a set of a plurality of pixels into a plurality of image object regions, comprising:  
when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, a group of boundary pixels interposed between a first group of pixels that constitute the first image object region and a second group of pixels that constitute the second image object region being detected as a boundary region between the first image object region and the second image object region based on pixel information on the pixels and predetermined region-determining conditions, a division line being determined in the boundary region based on the values of the pixels that constitute the boundary region, and the boundary region being divided into a region adjacent to the first image object region and the other region adjacent to the second image object region using the division line as a boundary.
3. The image processing method according to claim 2,  
pixels having intermediate values between the values of the pixels positioned along the boundary of the first image object region and the values of the pixels positioned along the boundary of the second image object region or values close to the intermediate values being selected as the division line in the boundary region so that the selected pixels are continuously arranged along the boundary.
4. An image processing method, comprising:  
synthesizing an arbitrary image object region in a target image including a set of a plurality of pixels with another background image,  
the arbitrary image object region being divided from another image object region adjacent to the image object through a boundary region together with the boundary region, based on pixel information on the pixels and predetermined region-determining conditions,

the image object region being synthesized with another background image together with the boundary region, and

the pixel values of a group of pixels that constitute the boundary region being controlled according to the pixel values of a group of pixels that constitute the background image.

5. The image processing method according to claim 4,  
the pixel values of the group of pixels that constitute the boundary region being controlled so that the difference in the pixel values between the group of pixels that constitute the boundary region and the group of pixels that constitute the background image is gradually reduced toward the background image.

6. The image processing method according to claim 4,  
transparencies of the pixel values of the group of pixels that constitute the boundary region being controlled to be gradually increased toward the background image.

7. The image processing method according to claim 1,  
the predetermined region-determining conditions being the following conditions 1 to 3:

(CONDITION 1) the first group of pixels is a group of pixels in which the difference in the pixel values between adjacent pixels is smaller than a predetermined threshold value A, and which are continuously arranged in a predetermined direction from an attention pixel;

(CONDITION 2) the group of boundary pixels is a group of pixels in which the difference in the pixel values between adjacent pixels is equal to or larger than the predetermined threshold value A and the difference in the changes in the pixel values between the adjacent pixels is smaller than a predetermined threshold value B, and which are continuously arranged in the predetermined direction from the first group of pixels; and

(CONDITION 3) the second group of pixels is a group of pixels in which the difference in the pixel values between adjacent pixels is smaller than the predetermined threshold value A and the difference in the pixel values between the first group of pixels and the second group of pixels is equal to or larger than a predetermined threshold value C, and which are continuously arranged in the predetermined direction from the group of boundary pixels.

8. An image processing apparatus to detect a target image including a set of a plurality of pixels in each of a plurality of image object regions, the image processing apparatus, comprising:

a boundary region detecting device to detect, when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, a group of boundary pixels interposed between a first group of pixels that constitute the first image object region and a second group of pixels that constitute the second image object region as a boundary region between the first image object region and the second image object region, based on pixel information on the pixels and predetermined region-determining conditions.

9. An image processing apparatus to detect a target image including a set of a plurality of pixels in each of a plurality of image object regions and to divide the image object regions to thus synthesize the divided image object regions with other background images, the image processing apparatus, comprising:

a boundary region detecting device to detect, when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, a group of boundary pixels interposed between a first group of pixels that constitute the first image object region and a second group of pixels that constitute the second image object region as a boundary region between the first image object region and the second image object region based on pixel information on the pixels and predetermined region-determining conditions; and

a region information generating device to divide any one of the first image object region and the second image object region together with the boundary region to thus synthesize the divided image object region and boundary region with the background image and to control the pixel values of the group of pixels that constitute the boundary region according to the pixel values of the group of pixels that constitute the background image.

10. An image processing program, comprising:

a program to detect a target image including a set of a plurality of pixels in each of a plurality of image object regions,

and to detect a boundary region when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, a group of boundary pixels interposed between a first group of pixels that constitute the first image object region and a second group of pixels that constitute the second image object region as a boundary region between the first image object region and the second image object region based on pixel information on the pixels and predetermined region-determining conditions.

11. An image processing program, comprising:

a program to detect a target image including a set of a plurality of pixels in each of a plurality of image object regions and to divide the image object regions to thus synthesize the divided image object regions with other background images;

to detect a boundary region when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, a group of boundary pixels interposed between a first group of pixels that constitute the first image object region and a second group of pixels that constitute the second image object region as a boundary region between the first image object region and the second image object region based on pixel information on the pixels and predetermined region-determining conditions; and

to generate a region information to divide any one of the first image object region and the second image object region from another adjacent image object region together with the boundary region to thus synthesize the divided image object region and boundary region with the background image and to control the pixel values of the group of pixels that constitute the boundary region according to the pixel values of the group of pixels that constitute the background image.

12. An image processing apparatus, for dividing a target image including a plurality of pixels into a plurality of image object regions based on pixel information on the pixels, comprising:

when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, in a group of pixels continuously arranged in a predetermined direction and existing on the boundary between the first image object region and the second image object region and in the vicinity of the boundary, the group of pixels composed of the pixels having intermediate characteristics between the characteristics of the first image object region and the characteristics of the second object region being detected as a boundary region between the first image object region and the second image object region based on predetermined region-determining conditions.

13. The image processing apparatus according to claim 12, further comprising:  
an image change detecting device to detect the pixels that belong to a first group of pixels including the pixels having the characteristics of the first image object region, a second group of pixels composed of the pixels having the characteristics of the second image object region, or a group of boundary pixels interposed between the first group of pixels and the second group of pixels, based on the characteristics of a plurality of pixels

continuously arranged in a predetermined direction from an attention pixel, which is an arbitrary pixel of the target image, and the predetermined region-determining conditions, and for identifying them by region attributes;

an image change information storing device to store the region attributes of the pixels detected by the image change detecting device in a predetermined storage unit as the pixel information on the pixels;

a closed region detecting device to detect a group of pixels composed of continuous pixels having the same region attributes as a closed region based on the region attributes of the pixels stored by the image change information storing device; and

a region information outputting device to output region information to identify the boundary region or the image object region to which the closed region detected by the closed region detecting device belongs.

14. The image processing apparatus according to claim 13, the predetermined region-determining conditions being the following conditions:

(CONDITION 1) the first group of pixels is a group of pixels in which the difference in the pixel values between adjacent pixels is smaller than a predetermined threshold value A, and which is continuously arranged in a predetermined direction from an attention pixel;

(CONDITION 2) the group of boundary pixels is a group of pixels in which the difference in the pixel values between adjacent pixels is equal to or larger than the predetermined threshold value A and the difference in the changes in the pixel values between the adjacent pixels is smaller than a predetermined threshold value B, and which are continuously arranged in the predetermined direction from the first group of pixels; and

(CONDITION 3) the second group of pixels is a group of pixels in which the difference in the pixel values between adjacent pixels is smaller than the predetermined threshold value A and the difference in the pixel values between the first group of pixels and the second group of pixels is equal to or larger than a predetermined threshold value C, and which are continuously arranged in the predetermined direction from the group of boundary pixels.

15. The image processing apparatus according to claim 13, the predetermined directions being at least two different directions among the directions of the lines that link the center of an attention pixel to the centers of the pixels that contact the attention pixel.

16. The image processing apparatus according to claim 12, further comprising:

a boundary region processing device to divide the boundary region between the detected first image object region and second image object region into two divided boundary regions based on predetermined boundary region dividing conditions and to determine to which region each of the divided boundary regions belongs between the first image object region and the second object region.

17. The image processing apparatus according to claim 12, further comprising:  
an image inputting device to input image information on the target image, to generate the pixel information on the pixels that constitute the target image, which is required to divide the target image into the image regions, and to store the pixel information in a predetermined storage unit.

18. The image processing apparatus according to claim 12, further comprising:  
a condition determining device to determine the predetermined region-determining conditions and to store the predetermined region-determining conditions in a predetermined storage unit.

19. An image processing method, comprising:  
dividing a target image including a plurality of pixels into a plurality of image regions based on pixel information on the pixels,  
when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, in a group of pixels continuously arranged in a predetermined direction and existing on the boundary between the first image object region and the second image object region and in the vicinity of the boundary, the group of pixels composed of the pixels having intermediate characteristics between the characteristics of the first image object region and the characteristics of the second object region being detected as a boundary region between the first image object region and the second image object region based on predetermined region-determining conditions.

20. The image processing method according to claim 19, further comprising:  
(a) detecting an image change by detecting the pixels that belong to a first group of pixels composed of the pixels having the characteristics of the first image object region, a second group of pixels composed of the pixels having the characteristics of the second image object region, or a group of boundary pixels interposed between the first group of pixels and the second group of pixels, based on the characteristics of a plurality of pixels continuously arranged in a predetermined direction from an attention pixel, which is an

arbitrary pixel of the target image, and the predetermined region-determining conditions, and of identifying them by region properties;

(b) storing an image change information by storing the region properties of the pixels detected by the image change detecting in a predetermined storage unit as the pixel information on the pixels;

(c) detecting a closed region by detecting a group of pixels composed of continuous pixels having the same region properties as a closed region based on the region properties of the pixels stored in the image change information storing; and

(d) outputting a region information by outputting region information to identify the boundary region or the image object region to which the closed region detected in the closed region detecting belongs.

21. The image processing method according to claim 20, further comprising:

between the closed region detecting (c) and the region information outputting (d), (e) processing a boundary region by dividing the boundary region between the first image object region and the second object region, which is detected in the image change detecting, into two divided boundary regions based on predetermined boundary region dividing conditions and of determining to which region each of the divided boundary regions belongs between the first image object region and the second object region.

22. An image processing program, comprising:

a program that divides a target image including a plurality of images into a plurality of image regions based on pixel information on the pixels and that is executable by a computer,

when one of adjacent image object regions is a first image object region and the other image object region is a second image object region, in a group of pixels continuously arranged in a predetermined direction and existing on the boundary between the first image object region and the second image object region and in the vicinity of the boundary, the group of pixels composed of the pixels having intermediate characteristics between the characteristics of the first image object region and the characteristics of the second object region being detected as a boundary region between the first image object region and the second image object region, based on predetermined region-determining conditions.

23. The image processing program according to claim 22, the program, further comprising:

(a) detecting an image change by detecting the pixels that belong to a first group of pixels composed of the pixels having the characteristics of the first image object region, a second group of pixels composed of the pixels having the characteristics of the second image object region, or a group of boundary pixels interposed between the first group of pixels and the second group of pixels, based on the characteristics of a plurality of pixels continuously arranged in a predetermined direction from an attention pixel, which is an arbitrary pixel of the target image, and the predetermined region-determining conditions, and of identifying them by region properties;

(b) storing an image change information by storing the region properties of the pixels detected in the image change detecting in a predetermined storage unit as the pixel information on the pixels;

(c) detecting a closed region by detecting a group of pixels composed of continuous pixels having the same region properties as a closed region based on the region properties of the pixels stored in the image change information storing;

(d) outputting a region information by outputting region information to identify the boundary region or the image object region to which the closed region detected in the closed region detecting belongs; and

(e) processing a boundary region by dividing the boundary region between the first image object region and the second object region, which is detected in the image change detecting, into two divided boundary regions based on predetermined boundary region dividing conditions and of determining to which region each of the divided boundary regions belongs between the first image object region and the second object region.

24. An image processing apparatus to divide the image information of a target image including a plurality of pixels into a plurality of image object regions based on pixel information on the pixels, comprising:

when an arbitrary image object region of the target image is used as a target image object region and the image object region in the target image, which is adjacent to the target image object region, is used as an adjacent image object region, in a group of pixels existing on the boundary between the target image object region and the adjacent image object region and in the vicinity of the boundary, the pixel information on the pixels that belong to a region corresponding to the group of pixels is generated based on the changes in the characteristics of the pixels in the predetermined directions in the group of pixels composed of the pixels having intermediate characteristics between the characteristics of the target image object region and the characteristics of the adjacent image object region.

25. The image processing apparatus according to claim 24, further comprising:  
a boundary region detecting device to detect, as a boundary region, the group of pixels composed of the pixels having the intermediate characteristics between the characteristics of the target image object region and the characteristics of the adjacent image object region in the group of pixels continuously arranged in a predetermined direction and existing in the vicinity of the boundary between the target image object region and the adjacent image object region, based on predetermined region-determining conditions; and  
a region information generating device to generate the pixel information on the pixels that belong to the boundary region, based on the changes in the characteristics of the pixels from the pixels that contact the target image object region to the pixels that contact the adjacent image object region out of the pixels that belong to the boundary region.

26. The image processing apparatus according to claim 25,  
the region information generating device including a transparency calculating device to calculate the transparencies of all of the pixels from the pixels in the boundary region adjacent to the target image object region to the pixels in the boundary region adjacent to the adjacent image object region in the pixels continuously arranged in a direction orthogonal to the boundary line between the target image object region and the boundary region, based on the ratio of the changes in the characteristics of the pixels from the pixels that contact the target image object region to the pixels that contact the adjacent image object region.

27. The image processing apparatus according to claim 26, the region information generating device including synthesized an image information generating device to update the pixel information on the pixels that belong to the boundary region to information suitable for the background image to generate the pixel information on a synthesized image, based on the image information on the background image adjacent to the boundary region and the transparencies calculated by the transparency calculating device, in the synthesized image obtained by synthesizing the group of pixels of the target image object region and the boundary region with the background image.

28. The image processing apparatus according to claim 26, further comprising:  
a region information outputting device to add the transparencies calculated by the transparency calculating device to the region information on the image object region and the pixel information on the pixels that belong to the boundary region as transparency information, and to output the added information as region information on the image object region.

29. The image processing apparatus according to claim 27, further comprising:  
a synthesized image information outputting device to output pixel information on the synthesized image generated by the synthesized image information generating device.

30. The image processing apparatus according to claim 25, the boundary region detecting device including: an image change detecting device to detect the pixels that belong to a first group of pixels composed of the pixels having the characteristics of the first image object region, a second group of pixels composed of the pixels having the characteristics of the second image object region, or a group of boundary pixels interposed between the first group of pixels and the second group of pixels, based on the characteristics of a plurality of pixels continuously arranged in a predetermined direction from an attention pixel, which is an arbitrary pixel of the target image, and the predetermined region-determining conditions, and to identify them by region properties;

an image change information storing device to store the region properties of the pixels detected by the image change detecting device in a predetermined storage unit as the pixel information on the pixels; and

a closed region detecting device to detect a group of pixels composed of continuous pixels having the same region properties as a closed region based on the region properties of the pixels stored by the image change information storing device.

31. The image processing apparatus according to claim 25, further comprising:  
a condition determining device to determine the predetermined region-determining conditions and to store the determined region-determining conditions in a predetermined storage unit.

32. The image processing apparatus according to claim 24, further comprising:  
an image inputting device to input the image information on the target image or the image information on the background image, generating the image information on the target image in a form of an internal process, and storing the generated image information in a predetermined storage unit.

33. An image processing method, comprising:  
dividing the image information of a target image including a plurality of pixels into a plurality of image object regions based on pixel information on the pixels,  
when an arbitrary image object region of the target image is used as a target image object region and the image object region in the target image, which is adjacent to the target image object region, is used as an adjacent image object region, in a group of pixels existing on the boundary between the target image object region and the adjacent image

object region and in the vicinity of the boundary, the pixel information on the pixels that belong to a region corresponding to the group of pixels being generated based on the changes in the characteristics of the pixels in the predetermined directions in the group of pixels composed of the pixels having intermediate characteristics between the characteristics of the target image object region and the characteristics of the adjacent image object region.

34. The image processing method according to claim 33, further comprising:

(a) detecting a boundary region by detecting the group of pixels composed of the pixels having the intermediate characteristics between the characteristics of the target image object region and the characteristics of the adjacent object region as a boundary region, based on predetermined region-determining conditions, in the group of pixels continuously arranged in a predetermined direction around the boundary between the target image object region and the adjacent image object region; and

(b) generating a region information by generating the pixel information on the pixels that belong to the boundary region, based on the changes in the characteristics of the pixels from the pixels that contact the target image object region to the pixels that contact the adjacent image object region out of the pixels that belong to the boundary region.

35. The image processing method according to claim 34,

the region information generating step (b) including calculating a transparency by calculating the transparencies of all of the pixels from the pixels of the boundary region adjacent to the target image object region to the pixels of the boundary region adjacent to the adjacent image object region in the pixels continuously arranged in a direction orthogonal to the boundary line between the target image object region and the boundary region, based on the ratio of the changes in the characteristics from the pixels that contact the target image object region to the pixels that contact the adjacent image object region.

36. The image processing method according to claim 35,

the region information generating (b) including generating an image information by updating the pixel information on the pixels that belong to the boundary region to information suitable for the background image and of generating the pixel information on a synthesized image, based on the image information on the background image adjacent to the boundary region and the transparencies calculated in the transparency calculating, in the synthesized image obtained by synthesizing the group of pixels of the target image object region and the boundary region with the background image.

37. The image processing method according to claim 35, further comprising:

outputting a region information by adding the transparencies calculated in the transparency calculating to the region information on the image object region and the pixel information on the pixels that belong to the boundary region as transparency information and of outputting the added information as region information on the image object region.

38. The image processing method according to claim 36, further comprising:  
outputting a synthesized image information by outputting image information on the synthesized image generated in the synthesized image information generating.

39. An image processing program, comprising:  
a program that divides the image information of a target image including a plurality of pixels into a plurality of image object regions based on pixel information on the pixels and that is executable by a computer,  
when an arbitrary image object region of the target image is used as a target image object region and the image object region of the target image, which is adjacent to the target image object region, is used as an adjacent image object region, in a group of pixels existing on the boundary between the target image object region and the adjacent image object region and in the vicinity of the boundary, the pixel information on the pixels that belong to a region corresponding to the group of pixels being generated based on the changes in the characteristics of the pixels in predetermined directions in the group of pixels composed of the pixels having intermediate characteristics between the characteristics of the target image object region and the characteristics of the adjacent image object region.

40. The image processing program according to claim 39, the program further comprising:

(a) detecting a boundary region by detecting the group of pixels composed of the pixels having the intermediate characteristics between the characteristics of the target image object region and the characteristics of the adjacent object region as a boundary region, based on predetermined region-determining conditions, in the group of pixels continuously arranged in a predetermined direction around the boundary between the target image object region and the adjacent image object region; and

(b) generating a region information by generating the pixel information on the pixels that belong to the boundary region, based on the changes in the characteristics of the pixels from the pixels that contact the target image object region to the pixels that contact the adjacent image object region out of the pixels that belong to the boundary region.

41. The image processing program according to claim 40,

the region information generating (b) including calculating a transparency by calculating the transparencies of all of the pixels from the pixels of the boundary region adjacent to the target image object region to the pixels of the boundary region adjacent to the adjacent image object region in the pixels continuously arranged in a direction orthogonal to the boundary line between the target image object region and the boundary region, based on the ratio of the changes in the characteristics of the pixels from the pixels that contact the target image object region to the pixels that contact the adjacent image object region.

42. The image processing program according to claim 41, the region information generating (b) including generating an image information by updating the pixel information on the pixels that belong to the boundary region to information suitable for the background image and of generating the pixel information on a synthesized image, based on the image information on the background image adjacent to the boundary region and the transparencies calculated in the transparency calculating device, in the synthesized image obtained by synthesizing the group of pixels of the target image object region and the boundary region with the background image.

43. The image processing program according to claim 41, further comprising: outputting a region information by adding the transparencies calculated in the transparency calculating to the region information on the image object region and the pixel information on the pixels that belong to the boundary region as transparency information and of outputting the added information as region information on the image object region.

44. The image processing program according to claim 42, further comprising: outputting a synthesized image information by outputting image information on the synthesized image generated in the synthesized image information generating.